

XII. *On the structure of the terminal segment in some male Hemiptera.* By DAVID SHARP, M.B., F.R.S., F.L.S., &c.

[Read February 5th, 1890.]

PLATES XII., XIII., & XIV.

THE arrangement of the subjects is as follows:—

1. *Introductory.*
2. *Description of the parts in various species.*
3. *Comparative observations on the separate structures.*
4. *General remarks.*

I. *Introductory.*

Although entomologists are now becoming acquainted with the remarkable and complicated structures connected with the organs of the male devoted to the fertilisation of the eggs of the female, it is probable that the subject has even yet not received so much attention as it deserves, and as it will doubtless secure in the future. There are several reasons for this comparative neglect; among them may be mentioned the extremely complex and varied nature of the structures: this not only renders them most difficult to describe intelligibly, but also has hitherto made it impossible to homologise the various parts seen in different insects, so that no satisfactory system of nomenclature for them has been established. To this may be added the great difficulty that exists in forming any idea of their true function.

I have recently been examining some heteropterous bugs, and I have found these structures in them remarkably easy of examination, and to a certain extent, perhaps, comprehensible as regards their function; and as very little, so far as I have been able to find, has been written about them, I have thought the following remarks about a few *Pentatomidæ* might possibly be of some value, notwithstanding their very imperfect and desultory nature.

In order to make my descriptions intelligible, I must briefly sketch the general conditions prevailing in the *Pentatomidæ*, as to the structure of the terminal (or genital) segment in the male sex.

First, it forms a cavity or chamber widely open externally, which I shall call the terminal chamber, and in this open chamber are placed the following structures, *viz.*:—1. The part of the male organs through which pass the membranous structures connected with the ejaculatory duct; this I shall call the *œdeagus*. 2. The termination of the alimentary canal; this is free and very mobile, and forms a sort of tail: I shall therefore call it the *rectal-cauda*. 3. Some accessory pieces or appendages, *viz.*, *a*, *lateral*, one on each side; *b*, *inferior*, a single piece. The general arrangement of these parts is that the *rectal-cauda* is in the middle above, and completely overlaps and covers the *œdeagus*, which is usually so completely concealed that I had examined many specimens without suspecting its existence until I discovered it by dissection; the lateral appendages are placed near the side-walls of the segment, one on each side, and are in many species very mobile, though in other cases very little power of movement appears to be present: the inferior accessory piece is placed on the middle of the inferior part of the segment directly below the termination of the *rectal-cauda*.

These parts exist in all the *Pentatomidæ* I have examined, and though so variable in form from species to species that they are not similar in any two I have seen, yet they are in all clearly homologous. There is another part, of a very peculiar and important nature, that is nearly always (perhaps I might say absolutely always) present, *viz.*, a tubular or cylindrical structure, fastened to the inner face of the floor of the chamber, and completely surrounding the *œdeagus*; it is, in fact, a fence or hedge, open only above; I will speak of it as the *theca*.

In order to complete this brief outline of the nomenclature I have used, I should add that the transverse deflexed wall separating the anterior part of the segment from the open posterior part is called the *diaphragm*, and that there frequently exists on each side of this *diaphragm* and close to the *rectal-cauda* a projection of variable form, which I have called the *superior lateral process*.

The posterior edge of the segment, which is very variable in form, is called the lip.

In reference to the Plates XII., XIII., XIV., which illustrate the following descriptions, I must say a few words of explanation. Such figures are very difficult to draw, owing to its being far from easy to see with definiteness into the depths of the chamber in which the pieces are placed; thus anyone who has not dissected specimens fails to catch the relations of the pieces, especially at their bases and in the depths of the chamber, and this has happened in the case of several of the figures here given. The structures, too, are much more delicate than the plates give an impression of, so that, owing to this and to the absence of colour in them, they do not convey at all adequately the idea of elegance and ornamentation which I think would be perceived by all who inspect the parts in their natural—especially if fresh—condition.

II. *Descriptions of the male characters in some species of Pentatomidæ.*

Owing to the kindness of my friend Mr. W. L. Distant, who has determined the species for me, and given me such other information as I sought from him, the names here used are no doubt correct; a most important point in such descriptions.

1. *Tesseratoma nigripes*, Dall.* (subfam. *Tesseratomine*). Hab. N. India. Fig. 2, Pl. XII.—The rectal-cauda is quite short and very broad, and its hind margin ciliate; behind it, but a little beyond it, there projects upwards the inferior process, which is of very hard consistence, subacuminate at the extremity, and concave in front; there is a space between it at the apex of the rectal-cauda, and there does not appear to be any special provision for defending the orifice of this latter part. The lateral appendages are very large and of complex form, the inner margin of each is accurately adapted to the side of the rectal-cauda, and, passing close to the inferior process, is furnished at the apex with a small abruptly bent-in process, which, when the inferior appen-

* This species has the peculiarity of having the lower wings beautifully coloured.

dage is depressed, is pressed upon by it, so that co-ordinated action between the inferior and the lateral appendages perhaps exists.

In this species the open face of the terminal chamber is very large, but is directed entirely upwards, and can be completely closed by the mere apposition of the inferior face of the hemi-elytra; at the hind margin of the chamber there is a large triangular incassation projecting anteriorly, and the apex of this process serves as a support to the extremity of the inferior accessory appendage when this is depressed.

2. *Tesseratoma papillosa*, Drury. Hab. China. Fig. 3, Pl. XII. — The position, arrangement, and relations of the pieces is similar to that described in the preceding species, but the shape of the chamber behind, and the texture, sculpture, and clothing of the various parts is quite different. These latter points are probably correlative with the striking difference in the colour and texture of the dorsal segments of the hind body in these two species.

3. *Tesseratoma malaya*, Stal. Hab. Hills of N. India. Fig. 1, Pl. XII.—Similar to *T. nigripes*, but with well-marked distinctions in the form of the lateral appendages.

4. *Eusthenes eurytus*, Distant (subfam. *Tesseratominæ*). Hab. N. India.—The rectal-cauda is here very short, not very broad, and only partially covers the cedeagus; only the bifid process terminating the latter can, however, be perceived, owing to the great development of the theca: this theca is of a most remarkable nature in this insect, being white and deeply striate, so that when the insect is in the natural condition of dampness it has the appearance of an assemblage of minute rods. Whether this be a post-mortem condition due to shrivelling I do not know. The rectal-cauda, in the only specimen at my disposal, is surrounded at the base by a folded and corrugate membrane, and I expect this permits the cauda to be slightly extended downwards so as to cover the theca. The inferior process is sub-acuminate at the extremity and concave in front, similar, in fact, to that of *Tesseratoma*, but smaller; the lateral appendages are very different in form from those of

Tesseratoma, especially as regards the internal terminal process, and I do not know whether this can be brought into such a position as to be pressed upon by the inferior process. There is no incrassation of the lip of the chamber in the middle behind.

The colour of the dorsal plates of the hind body in this insect is in life magnificent, being of a brilliant metallic colour, in tint between violet and purple. This fades after death, but may be restored by thoroughly wetting the insect.

The diaphragm projects strongly on each side of the cauda in an angular manner, forming thus a superior lateral process of a much less perfectly differentiated character than it assumes in many other species where it is present.

5. *Eusthenes pratti*, Dist. Hab. Central China. Fig. 4, Pl. XII.—The cauda is short, not deflexed, but projecting backwards, fuscous in colour, with white membranous extremity, the orifice open and exposed; the diaphragm surrounding the base of the cauda is white, membranous. The theca is a nearly transparent, white, longitudinally striated structure: from its middle projects the extremity of the *œdeagus*. This organ also is quite white, and appears seminmembranous, but is really of chitinous consistency; its exposed part is of irregular form, but possesses a large cleft along the middle, and from this there projects a perfectly transparent, very elongate, thread-like structure (the true intromittent organ, I presume): within the theca, on each side, there is a slender free wing, something like a small compressed rod; this is rather darker in colour than the other parts of the *œdeagus*.

The lateral appendages are placed rather deep down, and are therefore not very conspicuous, but are of complex form; the terminal part of each forms two lobes, one of which is slender and polished, and reflexed upwards just before the orifice of the cauda, its extremity just touching that of its fellow of the opposite side; the other lobe is much broader, placed more externally, and bears much long pubescence. The inferior process is placed just below the inner pair of the lobes of the lateral appendage, and is shaped like the terminal portion of the bowl of a spoon.

There is in this species an additional or superior lateral process on each side, in the shape of a projection inwards from the outer wall of the segment; it is a polished subacuminate process of black colour, placed at the side of the cauda just at the termination of the diaphragm.

In the figure of this species (Fig. 4, Pl. XII.) the shape of the segment is not well rendered, and the inferior process is not correct in shape.

6. *Eurostus grossipes*, Walk. (subfam. *Tesseratominæ*). Hab. N. India.—Of this remarkable species I have only a mutilated individual of the male sex at my disposal. The characters are in most respects similar to those of the other *Tesseratominæ* I have described, more especially to *Eusthenes eurytus*, but with differences in all the details, and with the important distinction that the inferior accessory process does not project upwards behind the processes of the lateral appendages, but remains below them: the rectal-cauda is moderately long, with its outer face deplanate, and it conceals the œdeagus, which is surrounded by a striated theca of pallid colour, but apparently of much less perfect structure than that of *Eusthenes eurytus*; the lateral appendages are large, and each is terminated by a free slender process extending upwards and backwards, and a little curved.

7. *Aspongopus obscurus* (subfam. *Dinidorinæ*). Hab. Assam.—The arrangements of the parts are similar to those of *Tesseratoma*, the lateral appendages being, however, very different in form; they are curved round behind the inferior process, and meet together in the middle at some little distance behind this inferior process, with which they are perfectly co-ordinated when the latter is depressed, and they are, too, furnished with a few elongate setæ at the points where the parts come into contact. A second species of the genus from the same locality differs chiefly in that the lateral appendages are still larger, and are in close contact with the inferior process.

8. *Piezosternum subulatum*, Fab. (subfam. *Dinidorinæ*). Hab. Bogota. Fig. 10, Pl. XIII.—The structures in this insect are so very different from those of *Aspongopus*

that the propriety of placing the two insects in the same subfamily may be doubted; the segment is, in fact, quite different in its plan from any other Pentatomid I have seen, and seems to approach in some respects the family *Pyrrhocoridae*. When the hemi-elytra are opened and the insect first inspected it seems as if all the parts were absent; the floor of the terminal chamber projects backwards, and its sides are curved upwards so that an imperfect cavity is formed, and all that can be seen is a transverse projection on the upper part of the anterior wall of this very open cavity. This is, however, due to the very great retractility of the terminal segment, and when the segment is extended to its full length, it is seen that the anterior part, which was covered during retraction by the preceding segment of the body, is the true terminal chamber, and the part behind it that was exposed is merely an adventitious growth. The orifice of the true terminal chamber looks directly upwards, but does not occupy anything like the whole of the upper aspect of the chamber, but is confined to an oval space on its centre; the orifice, too, is in larger part filled up by the rectal-cauda, which is not at all deflexed, but forms a horizontal roof in the position I have mentioned: immediately behind it there are two small projections nearly meeting in the middle; these are the lateral appendages; the projection I have alluded to previously as seen on the upper part of the anterior wall of the adventitious posterior cavity, it is now seen occupies the position of the inferior process. Although it has the form and somewhat the position of that part, as described in the *Tesseratominæ*, it differs in the important fact that it is not articulated, and also, of course, in the fact that it is placed altogether behind the lateral accessory processes, instead of in front of their terminations.

In considering the functions of the different parts hereafter, I shall state that I consider the function of the inferior lateral process to be that it determines the exact direction to be taken by the œdeagus when it is protruded, or rather deflexed. It is possible that the projection I am now speaking of in *P. subulatum* may have this function, though I very much doubt it.

On lifting up the rectal-cauda (and this is very easily done when the specimen is duly relaxed) the very large theca is seen occupying the greater part of the chamber,

and exposed in its upper part are the terminal pair of processes of the œdeagus.

9. *Megarhynchus limatus*, H.-S. (subfam. *Pentatominae*). Hab. Assam. Fig. 18, Pl. XIII. — Passing to the subfamily *Pentatominae*, we find the structures not only very different in appearance from those already considered, but evidently distinct in some of their functions. First, the position of the open face of the terminal chamber is different; instead of looking upwards it is directed backwards, and it is more completely withdrawn into the preceding segment; but when so retracted the structures by which the segment is closed are quite conspicuous without dissection, or even without the segment being extended or drawn out of its receptacle in the preceding segment.

In the extremely delicate and elegant *M. limatus*, the most conspicuous point in these parts is the rectal-cauda; this is delicately tinted, and extends downwards longitudinally along the segment, which it in great part closes; it is pointed at the extremity. On each side of it are seen the, also very conspicuous, lateral appendages; these are comparatively slender and free, and are somewhat like curvate compressed horns. The inferior process is a slightly raised, transverse ridge along the floor of the segment, and is emarginate in the middle so that the terminal point of the rectal-cauda fits accurately into it, and thus completely closes the orifice of the terminal chamber. Having only one specimen of this insect in my possession, I am unable to speak of the condition of the œdeagus and the theca; but the species is an interesting form, as the structures are much less highly evolved than they are in the next forms of *Pentatominae* I shall describe. Our European *Acanthosoma tristriatus* is somewhat allied in the structure of these parts to *Megarhynchus*, but is still more imperfect. Fig. 19, Pl. XIII.

10. *Nezara* sp., near *acuta*, Dall. (subfam. *Pentatominae*). Hab. Madagascar. Figs. 11 *a*, 11 *b*, 12, Pl. XIII. — This species, for which I am unable to find a specific name, was obtained by the Rev. Deans Cowan at Marosika, twenty miles north of Mahanoro, east coast of Madagascar, and is probably undescribed. The terminal

segment in the male is very retractile, and in the condition of repose is drawn so completely into the body that when the insect is looked at from above or below the segment appears to be entirely absent, but looked at from behind all the parts of the structure are displayed, and present a very remarkable appearance; the segment may be easily withdrawn by extension from the protection of the body, and it is then seen that the remarkable processes of the terminal chamber are really greatly exposed. In the middle there is seen a structure presenting a concavity somewhat like an oyster- or scallop-shell in shape, with raised margins: this is a portion of the rectal-cauda; on each side posteriorly the angles of the segment are flexed upwards and dilated, and are remarkably irregular in form; above them the superior angles of the chamber project backwards, and form on each side a process somewhat similar to the posterior angles; there is no inferior process behind the rectal-cauda; the lateral appendages are concealed in the large irregularly-shaped fissure existing between the superior and inferior angles, as above described, and the tip of the appendage just comes into contact with the peculiarly raised black margin of the reflexed inferior angle: on the middle of the dorsal part of the segment there is seen projecting backwards a process which, seen from above, looks very like the rectal-cauda of the *Tesseratominae*, and which, occupying as it does exactly the same position, would naturally be supposed to be the homologue of that part: but this is not so; this projection is a portion of the anterior chamber projecting backwards, and in all probability is homologous with the corrugated membrane I have described as existing at the base of the rectal-cauda in *Eusthenes eurytus*.

The rectal-cauda examined in detail is of remarkable structure; its basal part is placed under the process just mentioned, and is quite delicate and membranous, but immediately beyond this its outer aspect is developed into the peculiar shell-like structure I have already mentioned; beyond this shell-like piece there is a narrow chitinous strip, deflexed so as to be placed almost at right angles to the preceding part of the cauda, and the orifice of this cauda is directed quite downwards, and is surrounded by a protruding pale membrane.

The membranous basal portion of the rectal-cauda

acts as a sort of hinge, and allows the part to be lifted, and when this is done the œdeagus and its theca are seen placed just beneath the membranous basal part of the cauda; the theca is a large tubular or conico-tubular structure open at top only, and there displaying the extremity of the œdeagus, which consists of an extremely delicate minute tube and of a pair of plate-like lobes projecting just beyond the theca.

The reflexed and elevated posterior angles of the chamber in this species are, I think, clearly homologous with the transverse line, which I have described in *Megarhynchus limatus* as being the inferior process, and it should be noticed that different entirely as this part is from the inferior accessory appendage of the *Tesseratominæ*, yet the two have this in common, *viz.*, that the tips of the lateral appendages are co-ordinated with the inferior appendage, so that the two have clearly a relation in their movements.

11. *Nezara viridula*, L. Hab. Madagascar. Fig. 16, Pl. XIII.—This insect, though possessing a great superficial resemblance to *Nezara* sp.?, described above, differs so strongly from it in the male characters that I doubt whether the two can be correctly placed in the same genus. The characters, as will be seen on a comparison of the figures, are similar to those of the genus *Edessa*.

12. *Nezara marginata*, De Beauvois. Hab. Volcan de Chiriqui, Panama. Fig. 17, Pl. XIII.—The characters are very similar to those of *Nezara* sp.?, from Madagascar, the distinctions being in size and form of the various parts.

13. *Dalpada oculata* (subfam. *Pentatominae*). Hab. Assam.—The external characters, so far as I can see them in the only individual I possess, are not very remarkable; the rectal-cauda is very large, elongate, and greatly deflexed, and possesses along the middle a fine line having the appearance of a suture; the lateral appendages are very large, and are shining and polished, in strong contrast to the contiguous parts: there is apparently a small inferior process in the form of a

raised carina placed quite underneath the apex of the rectal-cauda. The œdeagus I am unable to see.

The most remarkable peculiarity in this insect is that the floor of the terminal chamber is divided at the bottom very far forwards, so that by a very slight projection of the rectal-cauda excrementitious matter is ejected outside the organism.

14. *Cappæa taprobanensis* (subfam. *Pentatominae*). Hab. Assam.—In this curiously coloured species the terminal segment is of smaller size than usual, and the lateral appendages are so deeply placed that I am not able to describe their form, to do which a special dissection would be necessary. The floor of the terminal chamber is deeply divided in the middle as far as the extremity of the rectal-cauda. This is narrower towards the apex, without sculpture, and overlaps the inferior process, which is therefore concealed by it. Though the species resembles *Dalpada oculata* in having the floor of the terminal chamber divided deeply, to allow the deposition of the excrement outside the segment, yet in the lateral appendages the two appear to be entirely different.

15. *Stilida indecora*, Stål (subfam. ?). Hab. Queensland. Figs. 5, 5a, 5b, Pl. XII. — The rectal-cauda is quite short, not deflexed, and the posterior part of its upper surface has a triangular area that is roughly punctured and pubescent. The œdeagus is quite concealed, but, on cutting off the rectal-cauda, it is seen to be very large, completely filling up the theca in which it is placed, and having the appearance of being a densely-packed bundle of corrugated membrane which has a groove in its posterior aspect, and in this there is placed a free, slender, slightly curved, chitinous ligula. The theca is smooth and polished. The lateral appendages are small, are placed very close to the rectal-cauda, and project backwards behind it as two slender, elongate, curved processes, whose apices just meet in the mesial line. The inferior process is almost entirely concealed by the rectal-cauda, but when this latter part is removed the inferior process is seen to be a rather slender, elongate ligula, placed immediately behind the theca, projecting backwards and upwards, quite smooth and polished, except a smooth portion at the tip, which is depressed and roughly sculptured.

16. *Edessa rufo-marginata*, DeGeer (subfam. *Pentatominae*). Hab. Central America. Figs. 6, 7, Pl. XII., 8, 9, Pl. XIII.—The rectal-cauda is very large, and is curved from above downwards, so that its orifice is not at all displayed, being, in fact, closely adpressed to the floor of the terminal chamber. The basal part of the cauda is quite cylindrical, smooth, and shining, but the median part of the cauda is thickened, and forms an angular chitinous process on each side; the two processes, viewed from behind, form together a flattened prominence, each outer edge of which is curved, and is densely fringed with ciliae directed outwards; the lower part of the cauda below the prominence is transversely striate.

The œdeagus is completely concealed by the cauda, but when this is removed the œdeagus is seen as a hard symmetrically formed polished black object, only the apex of which projects from the theca by which it is closely embraced, the theca forming, in fact, in the case of this species, a part of the œdeagus; the œdeagus has its free apex deeply and broadly grooved, and at the bottom of the groove in the middle there is a minute round orifice. The lateral appendages are large, and have a very irregularly formed terminal portion. There is no inferior appendage; but in this species there exists on each side a superior lateral process, projecting from the anterior wall of the terminal chamber: each process is bifid, and the edge of the posterior arm of the lateral appendage moves inward against the cleft.

17. *Edessa cornuta*, Burm. Hab. Guatemala, San Geronimo. Fig. 15, Pl. XIII.—The general disposition of the parts is similar to what has been described in *E. rufo-marginata*, but the shape of the lateral appendages is very different, and the ornamentation of the lower part of the rectal-cauda is very inferior.

18. *Edessa* sp. Hab. S. America, Corrientes. Fig. 14, Pl. XIII.—Although a very obscure insect, the development of the rectal-cauda is remarkable, and I have therefore figured it.

19. *Pharypia pulchella*, Drury. Hab. Pantaleon, Guatemala. Fig. 13, Pl. XIII. — The segment in this species is entirely black, and as the sides are a good deal produced beyond the pieces seated in the chamber, these

are difficult to see, and are not quite correctly rendered in the figure. The cauda has an angular incassation on each side (though not so represented in fig. 13), and the apices of the lateral appendages project, one on each side, as an obtuse rounded lobe; in the middle of the lip there is a small angular excision.

20. *Catacanthus incarnatus*, Drury (subfam. *Pentatomineæ*). Hab. E. India. Fig. 20, Pl. XIII. — Of this very beautiful bug I have only one male example at my disposal, and the arrangement of the parts of the genital segment is so complex and peculiar that these cannot be explained satisfactorily without breaking up a specimen. The lip of the segment is very deeply divided; the cauda appears to be short, and to bear a ciliate ovate ornament; the lateral appendages are very elongate, tusk-like processes, and there is a large superior lateral process on each side. In addition to this there are some peculiar complicated objects projecting from within, or from beneath the cauda, and these I cannot at present reconcile with anything I have seen in other species.

21. *Cantao ocellata* (subfam. *Scutellerinæ*). Hab. Himalaya.—The terminal segment is completely covered by the scutellum, and the tips of the wings project backwards beyond it. On extracting the segment it is seen that the rectal-cauda is moderately long, and is partly coloured black and yellow, and is hairy; it is closed at the extremity by a valvular membrane, at the base it is somewhat constricted, and is embraced on each side by the diaphragm, which is horizontal in its direction and emarginate for the reception of the base of the cauda, and emits forwards on each side a small, curved, corneous process closely applied to the cauda. On lifting the cauda the large theca is seen; it is transversely striate: the œdeagus cannot be seen. The inferior process forms a large inverted arch, which can be seen on the floor of the chamber below the cauda. The lateral appendage is seen on each side of the cauda as a small polished rounded process, whose extremity scarcely extends backwards at all beyond the diaphragm, which, as already stated, forms here a horizontal roof.

22. *Chrysocoris ornatus*, Dall. (subfam. *Scutellerinæ*). Hab. N. Indian Hills. Fig. 24, Pl. XIV.—This is a very highly modified form, so far as the external parts of the male segment are concerned. The diaphragm is very abruptly folded in, is corneous, but is pallid in colour, and is marked by numerous series of black file-like (or comb-like) asperities, arranged so as to form a pattern; there are altogether about fifty rows (of very different lengths) of these curious processes.*

The rectal-cauda is large, and extends nearly to the floor of the segment; it is in greater part corneous, but has a large sharply defined membranous patch at the extremity. The theca and œdeagus I cannot see. The lateral appendages are of peculiar form, and are seen, one on each side, as abruptly bent hooks, projecting towards the cauda; each hook bears on its basal part a patch of pubescence. The inferior process is a sharply defined carina, depressed in the middle, extending all across the floor of the segment, below the orifice of the cauda.

23. *Calliphara obscura*, Hope (subfam. *Scutellerinæ*). Hab. N. Borneo?. Fig. 25, Pl. XIV.—The floor of the terminal chamber is much produced posteriorly, and at the truncate apical angle on each side there is a large patch of peculiar scales similar to those mentioned in *C. ornatus*, though so different in their position. The rectal-cauda is large, laterally subcompressed, and subcarinate along the middle. The lateral appendage is a large horn-like process, much curved outwards, with dilated base. The inferior process can scarcely be distinguished.

24. *Pœcilochroma lata* (subfam. *Scutellerinæ*). Hab. Assam. Figs. 21, 22, 22a, 22b, Pl. XIV.—In this species the rectal-cauda is less developed than it is in any other *Pentatominae* I have examined, and appears merely as a small rounded process of a reddish colour pendent from the upper part of the terminal segment. There is apparently no theca, and owing to this fact, and to the small size of the cauda, the œdeagus is exposed; as seen

* Comb-like processes similar to these are found on the accessory male organs of some *Staphylinidæ*, where the male characters are very extremely developed, as in *Plociopterus*, for example.

without dissection its large upper face is noticed to be bifid. On taking out the cedeagus it is found to be a very remarkable organ; it is divided by a transverse joint into two parts: of these the lower is probably the theca; it is nearly cylindrical, polished, and bears some longitudinally raised lines; from the joint between it and the apical part of the cedeagus there spring, on the posterior aspect, two curious elongate tentacular processes of pallid colour; the apical half is of more complex structure, and is divided into two parts by a longitudinal cleft: on the posterior aspect, at the base of this cleft, there is an oval process just between the two tentacles I have already described; on the front aspect there is a prominent pointed process projecting, and on each side of this a pallid tentacle considerably shorter than those on the posterior aspect; the terminal face of the cedeagus presents the appearance of a broad truncate process of pallid colour, cleft along the middle, and bearing on each side of the cleft a large black oval prominence, the extremity of each prominence being free and pendent over the front of the cedeagus.

The lateral appendages in *Pacilochroma lata* are not very conspicuous, but consist of a polished spinose hook, placed one on each side, the apex of each hook being a little broader, so as to form a chisel-like edge. A second smaller hook, the superior lateral process, crosses the larger hook near its base, as if to afford it support.

The inferior process is absent on the mesial line, but on each side there is a raised carina extending far upwards, and it is from the upper part of this carina that proceeds the second hook I have mentioned above under the name of the superior lateral process.

25. *Pacilochroma hardwicki*, Hope (subfam. *Scutellerinae*). Hab. Himalaya. Fig. 23, Pl. XIV. — On extracting the terminal segment of the male, it is found to be broad, and the rectal-cauda is short, of a pallid tawny colour, hairy, and bears on each side of its upper face a curvate pointed spine or horn: the diaphragm is membranous and pallid in colour. On lifting the cauda the very large theca is displayed; it is smooth and polished: the cedeagus cannot be seen. The inferior process is seen below the cauda as a ridge or carina forming a curve with the concavity upwards. The lateral appendage is

seen on each side as a small, polished, curved process, projecting inwards from the lateral wall of the chamber, which is itself here prominent and projecting inwards.

26. *Calidea baro* (subfam. *Scutellerinæ*). Hab. Himalaya.—The terminal segment in the male, when extracted, appears to be entirely closed behind by a polished curtain, extending from the roof to the floor, and marked down the middle by a longitudinal groove; this curtain is the posterior face of the rectal-cauda, which is peculiar; the anterior face of the cauda is quite membranous, pallid in colour, and totally different from the external face; the tip of the cauda is closed by a membrane. On taking off the cauda it is found that the parts covered by it are difficult to distinguish well, being seated far forwards, and much enclosed; the theca is placed at the bottom of the segment, and from it projects forwards and upwards; this consists (so far as I can see in one example and without dissection) of five elongate rods, connected by a material of less hard texture, and of more pallid colour. The lateral appendages form two shell-like laminae, placed just behind the theca, and very deeply seated. The inferior process is a carina forming an inverted arch, whose arms are directed much forwards as well as upwards. There is a very prominent hooked process fixed to each side of the inner wall of the chamber, near its upper part.

27. *Brachyplatys* sp.? (subfam. *Plataspinae*). Hab. Old Calabar. Fig. 26, Pl. XIV.—The lip of the terminal chamber projects beyond the body so as to form a floor (the shaded part in figure, which is really horizontal in direction, though in the figure it looks perpendicular); there are no sides to the chamber, and the rectal-cauda has a small process closely applied to the extremity of the body and exposed posteriorly, though somewhat protected above by the slightly overhanging termination of the scutellum. The lateral appendages form two slender filaments. In the figure they are represented too large and not sufficiently close to the roof, or hind margin, of the scutellum.

28. *Brachyplatys* sp.? (subfam. *Plataspinae*). Hab. Marosika, Madagascar (*Cowan*). Fig. 27, Pl. XIV.—The terminal chamber has here disappeared, and the rectal-

cauda is a small papillary process, exposed at the lower part of the perpendicular shell-like process that forms the extremity of the abdomen. The lateral appendages are two very slender, small, curved spines, closely applied to the cauda, and not distinguishable without examination.

29. *Taricha nitens*, Dallas (subfam. *Plataspineæ*). Hab. Burmah. Fig. 28, Pl. XIV.—The terminal chamber is here also absent, and the small rectal-cauda is exposed at the apex of the body, but is somewhat protected by this being a little concave and somewhat overarched by the extremity of the scutellum. The lateral appendages are small curved spines, and the inferior process apparently exists as a small piece placed below, and closely applied to the rectal-cauda.

III. Comparative remarks on the various pieces.

The posterior or terminal chamber.—The terminal segment of the male in the *Pentatomidæ* consists of two parts—1, the terminal chamber, which is open above, or both above and behind; and 2, the anterior chamber, which is covered in, and contains, in addition to other structures, some powerful muscles. The general form of the segment is that of a cylindrical or conical body, of which a portion has been sliced off. The separation between the two chambers is effected in larger part by a diaphragm, which descends from the upper part more or less obliquely; this diaphragm thus forms the anterior wall of the posterior or terminal chamber.

In a large number of species the terminal chamber has its opening upwards; in *Nezara* and a number of others its open aspect is directly backwards; in *Piezosternum* the growth forming this chamber has become so extensive that it forms a completely closed receptacle, with an opening only in the middle of the roof, while behind it there is formed a portion of yet another chamber, a remarkable phenomenon which I have not found in any other Pentatomid. On the other hand, in the *Plataspineæ*, the posterior chamber is absent, but there exist on the end of the body the foundations, as it were, marking out its plan; and in the species of *Brachyplatys*, figured Pl. XIV., fig. 26, a portion of the floor of the chamber is present, and in another member of the

group, not otherwise mentioned in this paper, the structure and position of the terminal chamber is quite different from anything I have described; so that evidently in this group very extraordinary modifications are to be found.

The anterior chamber I shall not further allude to, as the parts with which I am now concerned are situated in the posterior chamber. Passing to this part: it will be seen that its posterior margin is to a greater or less extent unoccupied; this part may be conveniently called the lip, this term including the space between the inferior process and the hind margin of the segment. The lip varies extremely in its form; it may be prolonged in the middle, the prolongation differing in size and shape according to the species, or it may, on the contrary, be deeply divided along the middle, being thus more or less completely cleft into two halves. *Cantao ocellata* is an example of a species with the lip prolonged in the middle, while *Dalpada oculata* is one in which it is deeply divided.

In the species of *Tesseratoma* the lip bears in the middle a large raised process extending forwards towards the inferior process. I have not observed a similar process in any other genus.

The diaphragm.—This is the part that limits the posterior chamber in front, where it appears as a deflection of the upper surface on each side of and around the cauda; it differs greatly in its direction, in some descending perpendicularly, in others remaining nearly horizontal: it also differs greatly in texture, colour, and sculpture, and in the clothing it bears. It appears in its most remarkable condition in *Chrysocoris ornatus*, where it is very abruptly inflexed, pallid in colour, and large in extent, and ornamented with patches of black scales or asperities.

The rectal-cauda.—The rectal-cauda, or the cauda, as it may for the sake of brevity be better called, is the most remarkable of the external male characters in the *Pentatomidæ*. It differs, however, greatly in the different species and genera. It is comparatively insignificant in *Pæcilochroma lata*, but becomes a truly extraordinary process in *Edessa*, in *Nezara*, and in *Catacanthus*. In the larger *Tesseratominae*,—genera *Tesseratoma*, *Eusthenes*, and *Eurostus*,—it is horizontal in its direction, and

merely projects as a short horizontal process, terminating in the middle of the posterior chamber. In *Edessa* it extends the whole length of the segment along its middle, the orifice of the cauda being closed by apposition with the floor of the chamber at the part I have called the lip. In this genus, as well as in *Nezara* and *Catacanthus*, the cauda is ornamented by thickened processes or bosses, which are frequently covered with symmetrically curved ciliae.

Excepting only in *Pæcilochroma lata*, the cauda covers up the œdeagus, and for this purpose its under face is very peculiarly formed, being hollowed by a large cavity, the lips of which differ much in form and other respects in different species. In those genera where the cauda is elongate, *Nezara* and *Edessa*, e. g., it so completely encloses the œdeagus that that organ can only be brought into use when the cauda is got out of the way; for this purpose it is capable of elevation, and of being retracted to a considerable extent into the anterior chamber. The species of *Edessa* I have examined, notably *E. rufo-marginata*, afford a good illustration of this peculiarity.

In the *Plataspinae* the cauda forms a curious rounded, very slightly elevated, process, having no apparent orifice, owing to this being curved forwards and applied to the face of the segment, and protected beneath by a small carina.

Although I do not entertain any doubt as to the cauda being really the terminal portion of the alimentary canal, it is, perhaps, well to say that I have not verified this by tracing it forwards into the abdominal cavity.

The lateral appendages.—Although constantly present in the *Pentatomidae*, these appendages are not alike in form in any two species, and they, in fact, differ so extremely in their shapes that it is almost impossible to say anything of a general character as to this point. Their position is, however, constant, one on each side of the rectal-cauda, and frequently curving round behind its extremity. The anterior parts of the lateral appendages penetrate through or under the diaphragm, where their extremities are connected together by means of a strong ligament, which passes immediately behind, and presses on, the theca of the œdeagus. The lateral appendages are of very large size in the species of *Tesseratoma* and

in *Aspongopus obscurus*. In the *Plataspinae* they appear at first sight to be absent, but I have succeeded in detecting them in nearly all the species I have examined in the shape of curvate, slender, more or less minute, spines, placed one on each side of the protuberant boss formed by the curiously metamorphosed cauda.

The inferior process.—The usual form for the inferior process to take is that of a ridge or carina, extending transversely across the floor of the posterior chamber behind the œdeagus, and immediately below the terminal orifice of the cauda: this ridge may be depressed in the middle, or even quite divided into two separate parts by a deficiency in the middle, or by the division of the lip of the chamber into two lobes. On the other hand, the inferior process in certain species takes the form of a raised acuminate ligula, shaped much like the terminal portion of the bowl of a spoon; this is well seen in the *Tesseratominae*.

The theca.—The theca is always present, so far as I have observed, except in *Pacilochroma lata*, where it is apparently wanting. Like the other male parts here described, it varies greatly in different species in size, texture, and other points. It forms a fence surrounding the œdeagus, and open at the top to permit the passage of the true intromittent organ through the œdeagus. But in *Edessa rufo-marginata* the theca closely embraces, and in fact forms part of, the œdeagus; and in *Pacilochroma lata*, alluded to above, I have little doubt that the lower part of the œdeagus, as shown in fig. 22*a*, is really the theca, in which case this insect differs from other forms here described in that the theca is placed below the œdeagus instead of around it.

The function of the theca is no doubt like that of the rectal-cauda, to serve as a protection to the œdeagus, which it completely surrounds, except at the extremity. There is some evidence that the special duty of the theca may be to protect the œdeagus from the weight and pressure of the rectal-cauda. This evidence is as follows:—So far as I have yet observed there is only one Pentatomid—*Pacilochroma lata*—in which the œdeagus is not covered by the cauda, but stands up free and exposed behind the very short cauda. Now, this species is also the only one I have discovered in which the theca is apparently absent; but it would appear that if the theca

were a protecting shield for any other purpose than shelter against the pressure of the cauda, it would be specially required in this species: thus its absence where the cauda does not come into relation with the œdeagus suggests very strongly that its function is protection against the pressure of the cauda.

The œdeagus.—This of all the accessory male parts is, of course, the most important, being the part most directly engaged in the process of fertilisation. But it is of all the parts the most variable; it is, indeed, so extremely different that I cannot with certainty homologise the parts in some of the forms. As instances of extremely different forms of œdeagus I may mention *Pacilochroma lata*, *Eusthenes pratti*, *Stilida indecora*, *Edessa rufomarginata*, and *Piezosternum subulatum*. Notwithstanding the difficulties of homologising the parts of the œdeagus (which is complicated by its variable relations with the theca), I would suggest that it may ultimately prove to consist in all these insects of three parts, *viz.*, two lateral lobes similar to one another, and a single median ligula or style. But to assert this positively examinations must be made of a large number of species in a fresh condition.

The œdeagus in the *Pentatomidæ* is not capable of being thrust out of the body as it is in Coleoptera; it consists of two arms, the basal one of which is fastened to the floor of the terminal segment; to this basal portion the part of the œdeagus usually visible is fastened by a transverse joint. In repose this outer part of the œdeagus is bent up and so concealed, while for the purpose of copulation it is deflexed; if it exercise any movement during copulation—which appears to me very doubtful—it must be that of elevation or depression of the part external to the transverse joint.

The true intromittent organ, as seen in *E. pratti*, is a very elongate, transparent tube, similar to a glistening white thread; its great length is very remarkable.

IV. *General remarks.*

Although very little can be said as to the special functions of the parts I have described, and although it is as yet very difficult to form any idea likely to be of importance as to the reason of their existence, yet there

are some points of interest that may be alluded to with advantage.

The great variety seen is most remarkable. The forms I have described are merely such as I happened to have at hand, and were not selected to give any idea of the variety that exists in the *Pentatomidæ*; indeed, they do not do so, for I have, since the descriptions were made, examined a few other members of the family, and find some of them to be quite different from anything here delineated. They are also very different from anything that exists in Coleoptera, and no similar system of arrangement of the parts has been described, so far as I know, in other insects.

Another point that strikes the attention is the fact that in some species, especially in the genera *Edessa* and *Nezara*, the structures appear to be of an ornamental character.

On comparing a heteropterous hemipteron with a male insect of another order—a beetle, say—an important difference will be observed, *viz.*, that one whole segment of the body is greatly separated from the other segments, and entirely devoted to the reception of the male parts, but the parts are not withdrawn completely into the body; indeed, the greater portion of the segment is exposed, and the part of it in which the structures I have described are situated is left uncovered, except by the membranous tips of the upper wings. It must be noted, too, that in all cases where there is a complex ornamentation of the parts, they are freely exposed, and not covered by the tips of the wing-cases. In the *Scutellerinæ*, where the scutellum assumes such extraordinary dimensions that it entirely covers the body, the terminal segment is, like the other parts, covered by the monstrous scutellum; but in the *Plataspinæ*, where the scutellum is quite as greatly developed as it is in the *Scutellerinæ*, perhaps even more so, the parts are not covered by it, but are exposed on the perpendicular extremity of the body, or are even placed on the under surface; and in *Edessa* and *Nezara* the posterior aspect of the segment is not covered in any way, though apparently it can be concealed occasionally by bending down the delicate tips of the wings which usually project beyond it.

It may be proper here to notice that in the male

Pentatomidæ the segment preceding the genital segment is also highly modified for sexual purposes, being greatly diminished in size, and, in fact, differentiated almost entirely for the purpose of forming a remarkably perfect articulation at the base of the genital segment. It is, in fact, in the normal condition of repose, quite concealed between the terminal and the ante-penultimate segments, so that there appears to be one segment less in the male than there is in the female, both on the dorsal and ventral aspects. In some species,—those of the genus *Tesseratoma*, for example,—there is a stigma present on this rudimentary segment, proving it to be a true segment, and not a mere articulating ring.

The extreme difference between the arrangement and general conditions of the male parts in the *Pentatomidæ* and the Coleoptera is, I believe, correlative with a different method of copulation in the two orders. In the Coleoptera it is the rule that the male is placed above the female during coupling, while in the Hemiptera-Heteroptera the general rule seems to be that the male creeps beneath the female: in this latter sex the vulva is invariably placed quite on the under surface of the body, and not in the last segment of the body, but in that preceding it; and the general arrangement of the parts in the other sex are evidently correlatively modified.

The most striking of the special features of the genital segment is the peculiar development of the alimentary canal. The chief function of this rectal-cauda is to protect the œdeagus, which lies completely beneath it. For this purpose the under side of the rectal-cauda is hollowed by a large cavity, and the part of this cavity immediately above the œdeagus is reduced to the consistency of a delicate membrane; thus the calibre of the canal of the interior of the cauda is entirely contracted at this spot, so that a very remarkable protecting cap for the œdeagus is obtained at the cost of obstructing the canal to such an extent that passage of excrementitious matter can only be made by either depressing the œdeagus or by raising the cauda off the œdeagus.

It appears to be a great comfort or advantage to insects to be able to withdraw and cover over some of the sensitive parts of the body during repose, or when the parts are not in use; for this purpose a very large

number of Coleoptera are provided with special cavities, in which they can withdraw the sensitive portions of the antennæ; and in many cases complete protection is obtained for the sensitive parts of the mouth by various modifications for retracting the mouth within the thoracic cavity, or under protection of a projecting part of the thorax (the chin-piece in *Histeridæ* and *Elateridæ*, for example), or by inflecting the head in a peculiar manner. The modifications of some parts of the skeleton for these purposes is truly marvellous, as any one who has examined the extraordinary modifications of the sternum in the *Anobiidæ* will admit; and it is therefore quite consistent with what we find to obtain in insect economy that the alimentary canal at the other extremity of the body should be made to protect the œdeagus, and the fact justifies us to some extent in inferring that the œdeagus, or some part of it, is a sensitive organ; but it is, on the other hand, equally probable that the delicate structures of the œdeagus are covered simply to preserve them from injury.

I have stated, in speaking of the rectal-cauda, that in many forms it does not extend to the extremity of the body, but terminates in the middle of the genital segment. This certainly is a very curious arrangement, and at present I am not able to state any incontrovertible reason for the abbreviation. Evidently the cauda,—*i. e.*, the alimentary canal,—ought to extend to the extremity of the body; for it does so in the female *Pentatomidæ* in a conspicuous manner, and it does so in the males of many species. It would hence appear that its abbreviation in some forms must be looked on as a departure from the natural arrangement of the parts. And it must be considered a very peculiar departure, for it is difficult to understand how in such cases the excrementitious matter is extruded entirely from the body. Mr. Champion tells me that he is under the impression that some bugs have the power of forcibly ejecting the excrementitious matter by a sort of squirting process; but if this be the method employed in the *Scutellerinæ*, it must be accompanied by a process of simultaneously spreading the wings so as to get their tips out of the way, while at the same time the genital segment must be greatly exerted so as to extend it beyond the tip of the scutellar covering of the body. I have

little doubt, however, that this segment is capable of being so extended, for it is by such an extension that I presume the process of coupling to be rendered possible. Still, there are other considerations that make it difficult to believe that in these *Tesseratominae* and *Scutellerinae* the alimentary canal can have become shortened by a process of evolution. Without referring to these more particularly at present, I will content myself with saying that it appears more probable that the original termination of the genital segment was at the line of the diaphragm, and that the part posterior to this—that is, the posterior chamber, in which the external male parts are situated—is a subsequent growth that has taken place *pari passu* with the evolution of the male parts for the purpose of their protection. If so, then both the posterior chamber and the peculiar modifications of the rectal-cauda are to be looked on as having as their objective result the protection of the œdeagus.

With reference to the special function of the lateral appendages and the inferior process, I can only make vague suggestions which actual observation may probably prove to be erroneous. Where the inferior process is specially developed, it perhaps determines the exact direction the œdeagus shall take when it is deflexed. The function of the lateral appendages is at present more obscure, but they are always present, and probably play an important part in the act of copulation. I have stated that they are connected together by a powerful ligament pressing on the back of the theca of the œdeagus, and, on breaking up a specimen of *Eusthenes pratti*, I find that this is just at the spot where the ejaculatory canal passes into the theca; it is therefore quite probable that the lateral appendages have a controlling power over the passage of the seminal fluid.

I see no reason for considering, with any great probability, that any part of the structures are clasping or holding instruments. I look on them as (1) for protection of the sensitive parts from pressure, (2) for the exclusion of parasites, (3) as directing instruments to determine the exact direction of movement of the true intromittent organs, and (4) as probably instruments for altering the pressure on the ejaculatory canal at its point of entrance into the œdeagus; but the superior lateral processes, which are only present in some species,

and are always fixtures, may be of the nature of supports or holdfasts. My suggestion as to the protective functions of some of the parts is, I think, of importance; this, indeed, is probably one of the reasons why the structures I have been speaking of differ so much in their general arrangement from what they do in the other orders of insects. In the Coleoptera, for instance, protection is obtained by withdrawing the whole of the male organs and their accessory parts into the interior of the body; whereas in the Hemiptera the organs are not withdrawn into the body to an extent sufficient to protect them; and it appears probable that the cavity in which they are lodged is a special outgrowth for their protection and accommodation. According to embryological data obtained in other insects the œdeagus was originally, wholly or in part, an external organ of the nature of an appendage, and if this be the case, the mode of evolution of forms in which it is now drawn completely—with all its complex accessory parts—into the interior of the body must have been totally different from the development in the Hemiptera, where it remains homologically an external organ, with special arrangements for covering it.

The æsthetic aspect of the arrangement in many of the higher species, such as *Catacanthus*, *Nezara*, and *Edessa*, is very remarkable, but I do not think there is at present evidence that would justify us in attaching any special biological importance to it. It certainly is a most remarkable fact that the posterior part of the alimentary canal should be used as an external organ for the protection of other parts, and that it should become adorned with bosses and projections symmetrically formed and elegantly ciliated; and the idea is almost suggested that these peculiarities are of use in producing some impression on the other sex. But I think this idea may be dismissed as in all probability quite untenable.

Not the least curious point in these organs is the great variety of forms they present. The variations in the shapes of the lateral appendages and of the inferior process are truly extraordinary, but they are insignificant as compared with the extreme differences that exist in the œdeagus itself. If this organ, as seen in *Eusthenes pratti*, in *Stilida indecora*, *Edessa rufo-marginata*, *Pœcilo-*

chroma lata, and *P. hardwicki*, be compared, it will be understood how difficult it is to recognise the homologous parts; and it is not easy to see how such very different organs can have the same function. Indeed, the great variety existing in so important a part, and one so closely connected with the continuance of the species, will, I think, prove to be very difficult of explanation to those who adopt the theory of a common ancestor for species systematically allied.

Finally, I may remark that I have not observed any variation whatever in the parts in individuals of the same species.

EXPLANATION OF PLATES XII., XIII., & XIV.

PLATE XII.

FIG. 1. *Tesseratoma malaya*, Stal, viewed from above; *l.a.* lateral appendage, *i.* inferior accessory process, *c.* rectal-cauda.

FIG. 2. *T. nigripes*, Dallas, viewed from above; *l.a.* lateral appendage, *i.* inferior accessory process, *c.* rectal-cauda.

FIG. 3. *T. papillosa*, Drury, viewed from above, with one of the lateral appendages, *l.a.*, partially rotated or lifted.

FIG. 4. *Eusthenes pratti*, Distant, viewed from behind and slightly from above; *l.a.* lateral appendage, *i.* inferior accessory process, *c.* rectal-cauda, *l.p.* superior lateral process.

FIG. 5. *Stilida indecora*, Stal, showing the normal position of the terminal segment, *t.s.*, when retracted.

FIG. 5A. Terminal segment of *S. indecora*, viewed from above; *l.a.* lateral appendage, *i.* inferior accessory process, *c.* rectal-cauda.

FIG. 5B. *S. indecora*, after the rectal-cauda, diaphragm, and one lateral appendage have been dissected off, viewed from above and a little in front; *l.a.* lateral appendage, *i.* inferior process, *o.* œdeagus consisting of semimembranous corrugated substance, *o.s.* style of œdeagus, *t.* theca.

FIG. 6. *Edessa rufo-marginata*, DeGeer, viewed from above; *l.a.* lateral appendage, *i.* inferior accessory process, *c.* rectal-cauda, *l.p.* superior lateral process.

FIG. 7. The same, viewed from behind and a little from below; the rectal-cauda is very large, and extends all along the middle of the figure: the lower part is not quite correctly rendered by the artist.

PLATE XIII.

FIG. 8. *E. rufo-marginata*, with the rectal-cauda (*c*) elevated and drawn in, and the œdeagus deflexed so that its apical part (*o*) is protruded; *a. o.* orifice of rectal-cauda, *l. a.* lateral appendage, *t.* theca.

FIG. 9. *E. rufo-marginata*; A, rectal-cauda dissected off, showing the large excavation (*h*) on its under surface for the accommodation of the extremity of the œdeagus; B, under surface of termination of rectal-cauda, showing the orifice or anal aperture *a. o.*; *c.* upper surface of rectal-cauda; D, œdeagus (*o.*) closely embraced by its theca (*t.*).

FIG. 10. *Piezosternum subulatum*, Fab., viewed directly from above; *c.* cauda retracted and elevated, *l. a.* presumed lateral lobes of œdeagus, *i.* inferior accessory process; the lateral appendages are not lettered, but are seen behind the lobes of the œdeagus.

FIG. 11. *Nezara* sp.? (Madagascar, Cowan); A, viewed from above; B, from behind; *c.* rectal-cauda, *l. a.* lateral appendage.

FIG. 12. The same (*Nezara* sp.?, Madagascar, Cowan), after the rectal-cauda has been dissected off, viewed from above and in front; *o.* œdeagus, *t.* theca.

FIG. 13. *Pharypia pulchella*, seen from behind and slightly from below. The artist has not succeeded with this figure; the parts being all deep black, it is rather difficult to see the outlines.

FIG. 14. *Edessa* sp.? (Corrientes), showing the ornamented rectal-cauda extending all along the middle of the segment.

FIG. 15. *Edessa cornuta*, Burn., viewed from behind; *c.* rectal-cauda, *l. a.* lateral appendage, the shape of this latter not correct.

FIG. 16. *Nezara viridula*, L. (Madagascar), viewed directly from behind; *c.* rectal-cauda, *l. a.* lateral appendage.

FIG. 17. *N. marginata*, De Beauv., viewed from behind and a little from one side; *c.* the large and complicated rectal-cauda.

FIG. 18. *Megarhynchus limatus*, H.-S., viewed from behind.

FIG. 19. *Acanthosoma* (*Cyphostethus*) *tristriatus*, viewed from behind; *l. a.* lateral appendage, *c.* rectal-cauda.

FIG. 20. *Catacanthus incarnaius*, Drury; *c.* ornament on rectal-cauda.

PLATE XIV.

FIG. 21. *Pœcilochroma lata*, seen from above; *o.* œdeagus, *c.* the very short rectal-cauda.

FIG. 22. *P. lata*, seen from behind.

FIG. 22A. *P. lata*, œdeagus, lateral view; *o.* œdeagus proper, *t.* presumed theca.

FIG. 22B. *P. lata*, œdeagus proper, posterior aspect.

FIG. 23. *P. hardwicki*, seen from behind; *l.a.* lateral appendage (form incorrect), *d.* diaphragm, *c.* rectal-cauda, *h.* horns attached to cauda, *i.* terminal orifice of cauda.

FIG. 24. *Chrysocoris ornatus*, Dall., viewed from behind; *l.a.* lateral appendage, *c.* cauda. Bad figure.

FIG. 25. *Calliphara obscura*, viewed from above and a little in front; *c.* rectal-cauda, *l.a.* lateral appendage.

FIG. 26. *Brachyplatys* sp.? (from Old Calabar), viewed from behind; *c.* rectal-cauda, *l.a.* lateral appendage (figured too large and projecting too much downwards).

FIG. 27. *Brachyplatys* sp.? (Marosika, Madagascar, Cowan), viewed from behind and slightly from below; *c.* rectal-cauda, *l.a.* lateral appendage.

FIG. 28. *Taricha nitens*, viewed from behind and slightly from below; *c.* rectal-cauda, *l.a.* lateral appendage (too large and prominent).